LENGTH MEASUREMENTS OF LAKE YELLOWSTONE TROUT

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The U. S. Fish and Wildlife Service and its predecessor, the U. S. Bureau of Fisheries, has conducted biological studies of the Yellowstone black-spotted trout (Salmo clarki lewisi) on Yellowstone Lake and its tributaries since 1936. Prior to that year, considerable knowledge pertaining to the biology, culture, and life history of this species had been secured through the efforts of U. S. Fishery Station personnel engaged in egg-taking operations in these waters. The 1936 beginnings of organized investigations into the habits of the Yellowstone black-spotted trout in its native waters took the form of surveys and collection of biological data by Dr. Leonard Schultz and Mr. Richard Foster. Mr. Foster continued the biological work in 1937, and Mr. Marion Madsen conducted investigations in 1938 and 1939. In 1942, and for three years thereafter, Dr. Stillman Wright supervised Yellowstone studies on this species, and was able to secure more extensive data than had been available to the earlier workers. Dr. Wright and his assistants inaugurated a system for systematically counting and measuring spawners in key streams, and gathered much other morphometric data over a period of a few years. Most of this work was deemphasized toward the end of the war, but hatchery personnel continued the sequence of some phases of the work.

In 1950, intensive studies were undertaken to cover several aspects of the fishery problem on Yellowstone Lake, and many features of the earlier programs were revived. Most of the studies were attacked on larger scales than previously. The 1950 investigations were continued in 1951 and 1952.

This paper pertains to lengths of fish handled during the progress of the various investigations. This information is deemed important chiefly because of the value of year-to-year changes in lengths of fish as a basis for recognition of critical alterations in the composition of populations. Such trends, especially when viewed in connection with other changes occuring in the fishery, often supply weighty evidence of population improvement or decline. Reliable measurements of length also help in the recognition of separate populations that may exist in the same or connected bodies of water.

The purpose of these studies and this report has been to assemble all known information on lengths of black-spotted trout in Yellowstone Lake for critical examination and comparison. Comparisons have been made between differences in mean total length from year to year and from place to place within the drainage. Information on trends is essential as a part of the general investigative program leading toward recommendations pertaining to the regulation of the Lake Yellowstone fishery.

METHODS

Field methods used in this study have consisted of measuring adult fish on measuring boards. The metric system has been used by all workers.

Early measurements were made to the nearest millimeter; at later stages, some measurements were made to the nearest centimeter. The 1949 measurements and all subsequent work, were made to the nearest five millimeters. In this paper, mean total lengths are reported to the nearest tenth of a millimeter.

Some early measurements were made on the basis of standard length and some on total length. The 1949 measurements and some 1950 measurements were on the basis of fork length, but all measurements have been brought into agreement through conversion to total length. Table 1 is a conversion table treating standard, fork, and total lengths and is based on measurements made on several thousand Yellowstone black-spotted trout from Yellowstone Lake and its tributaries. These results will be discussed below.

Comparisons reported here have been made with the "t" test for comparison of means. Standard deviations of mean lengths and "t" values are reported where they apply.

Field measurements have been carefully screened before being used, in order that reliable comparisons could be made. For instance, measurements made over a period of only a few weeks have been discarded as not representing an entire season's values. The spawning season usually lasts eight to ten weeks, and the fishing season extends from May 30 to October 15. Measurements from different parts of the lake and individual streams have been treated separately. Comparisons between small numbers of measurements have been avoided because they have usually not been representative of their populations.

CONVERSION FACTORS

Table 1 relates measurements in standard, fork, and total lengths. These data are based on thousands of measurements in which sexes, localities, and size ranges are combined. Relationships between standard length and total length were found to vary between sexes and from place to place. Hile (1941) discussed similar variations with respect to rock bass, and showed that in the larger size groups males have longer tails than females. This feature is seen in the present data relating to cutthroat trout. It is reasonable to expect differences because of variation in method from person to person or for extremes in size ranges to reflect growth character. Carlander and Smith (1945) mentioned a proportional shortening of the caudal fin as perch, walleye pike, and crappies increase in length. Beckman (1948) reported that this was also true for bluegill, yellow perch, pumpkinseed, smallmouth bass, largemouth bass, rock bass and northern pike in Michigan, and Van Oosten noted it for sheepshead (1938) and Lake Huron whitefish (1939).

Table 1.-Conversion tables for standard length, fork length and total length; Salmo clarki lewisi, Yellowstone Lake, Wyoming. (Measurements are expressed to the nearest millimeter)

Standard Length	Fork Length	Total Length
210	228	241
215	234	246
220	239	252
225	245	258
230	250	264
235	256	269
240	261	275
245	266	281
250	272	287
255	277	292
260	283	298
265	288	304
270	294	309
275	299	315
280	304	321
285	310	327
290	315	332
295	321	338
300	326	344
305	332	350
310	337	355
315	343	361
320	348	367
325	353	372
330	359	378
335	364	384
340	370	390
345	375	395
350	381	401
355	386	407
360	391	413
365	397	418
370	402	424
375	408	430
380	413	436
385	419	441
390	424	447
395	430	453

Robertson (1947) reported that 63 specimens of Salmo clarki lewisi from Upper No Name Lake in Wyoming exhibited variations in standard length--total length relationship according to size of fish. Five-inch fish had a factor of 0.826 (total length to standard length), while 20-inch fish had a factor of 0.877. The mean figure for the 63 fish was 0.863.

The present Yellowstone data have not been analyzed with respect to size of fish in relation to conversion factors. Table 1 is restricted to sizes of black-spotted trout from 241 millimeters (9.5 inches) total length to 453 millimeters (17.8 inches). Conversion factors as reported by Robertson would range from approximately 0.861 to 0.874 for fish of these sizes. These values cause a difference of no more than two millimeters on the converted length when applied to fish within this size range. Factors listed in Table 2 are presented for use over the entire range from 241 to 453 millimeters with the qualification that measurements on fish at the extremesof the range may be as much as two millimeters in error after the conversion.

Robertson's conversion factor, 0.863, corresponds with the factor, 0.8725, for Yellowstone Lake fish. A fish of 350 millimeters total length would be 302.05 millimeters in standard length according to the Robertson factor, and 305.38 with the Yellowstone factor.

Fleener (1952) reported conversion factors, 1.1950 (standard length to total length) and 0.8367 (total length to standard length), for 305 cutthroat trout in Logan River, Utah. Fish on which these factors are based measured from 40 to 290 millimeters in total length. These factors, based on both sexes, differ somewhat from the Yellowstone and Robertson factors. This is to be expected, since the Logan River fish were considerably smaller than those used in the other two studies. The occurrence of a proportional decrease in caudal fin size with increase in length of fish suggests agreement with the observations of Carlander and Smith, of Robertson, and of Hile. Another possible reason for the difference between the Logan River and the Yellowstone factors lies in the fact that the quality of Logan River stock is not known. There has been ample opportunity for hybridization between species and between subspecies in this stream, and it is not certain that cutthroat of Yellowstone origin only have been introduced in the many cutthroat plantings that have taken place here.

Factors pertaining to males do not bear a consistent relationship to factors relating to females in these Yellowstone data. Table 2 shows, for example, that, for males conversion from standard to fork and to total length, the factors are greater than for females. Conversion from fork length to total length, however, shows the factor for females to be higher than that for males. It is possible for this relationship to exist but probably the real reason for this discrepancy lies in the fact that different populations of fish were used for the measurements. Factors relating fork and total length were derived from Arnica Creek fish (see Figure 1,

Table 2.-Conversion factors for standard length, fork length and total length, Salmo clarki lewisi, Yellowstone Lake, Wyoming. (Applicable to fish of total length between 240 and 450 millimeters)

	Female	Male	Sexes Combined
Standard length to total length	1.1413	1.1480	1.1461
Standard length to fork length	1.0817	1.0907	1.0874
Total length to standard length	0.8762	0.8711	0.8725
Total length to fork length	0.9478	0.9501	0.9488
Fork length to total length	1.0550	1.0524	1.0539
Fork length to standard length	0.9244	0.9168	0.9195

West Thumb area), while those pertaining to standard and total length came from data taken by Dr. Wright and his associates at Grouse, Chipmunk, and Pelican Creeks. The differences in factor values between these populations of fish appear to be so minute as to be of little practical importance. The use of values for the combined sexes when applied to fish of either sex will usually give converted measurements that are within one millimeter of the actual values.

SPAWNING TROUT

Spawners from five streams tributary to Yellowstone Lake have been measured during the past several seasons. The Pelican Creek measurements, extending over seven seasons, is the longest series for which data are available. Unfortunately, data from some years are not suitable for comparison because of unbalanced sampling distribution within individual seasons. In some cases too many small fish were measured to yield a mean total length measurement truly representative of the population.

The criteria for the acceptance of a set of data were based on sampling distribution and total number measured. The requirement for acceptance was that the sample must have been taken at two or three day intervals throughout the entire season and that the total number measured be at least in the neighborhood of 350 fish. Table 3 shows that only four season's measurements on Pelican Creek were deemed satisfactory for comparison. Chipmunk Creek, which enters the South Arm of Yellowstone Lake, provided data for six seasons, and three of the six are satisfactory. Grouse Creek provided three good seasons out of five; Arnica Creek yielded three excellent seasons of data; Yellowstone River, at the Cascades, five miles downstream from Fishing Bridge gave one good season out of two. Cascade fish, unlike those of other groups treated here, were not caught in permanent traps but were taken in dip nets as they ascended the steep rapids during the spawning run.

Table 3 summarizes statistical comparisons between mean total lengths of spawners from year to year. These comparisons indicate the direction and extent of trends in sizes of spawners and in some cases show that trends have been moderately continuous. Pelican Creek shows three changes that are statistically significant--1945 fish averaged 9 millimeters longer than the 1952 group, 1950 fish were 8.4 millimeters longer than the 1952 fish, and 1951 fish were 7.2 millimeters longer than the 1952 fish. In Arnica Creek, a similar decrease in fish length was seen from 1950 to 1952. The 1950 fish averaged 367.6 millimeters (14.5 inches), 1951 spawners averaged 362.8 millimeters (14.3 inches) and the 1952 average was 353.5 millimeters (13.9 inches).

Chipmunk Creek fish, on the other hand, showed increases in mean total length from year to year. Lengths in 1945 averaged 364.9 millimeters (14.4 inches); in 1950, 378.6 millimeters (14.9 inches), and in 1951, 385.7 milli-

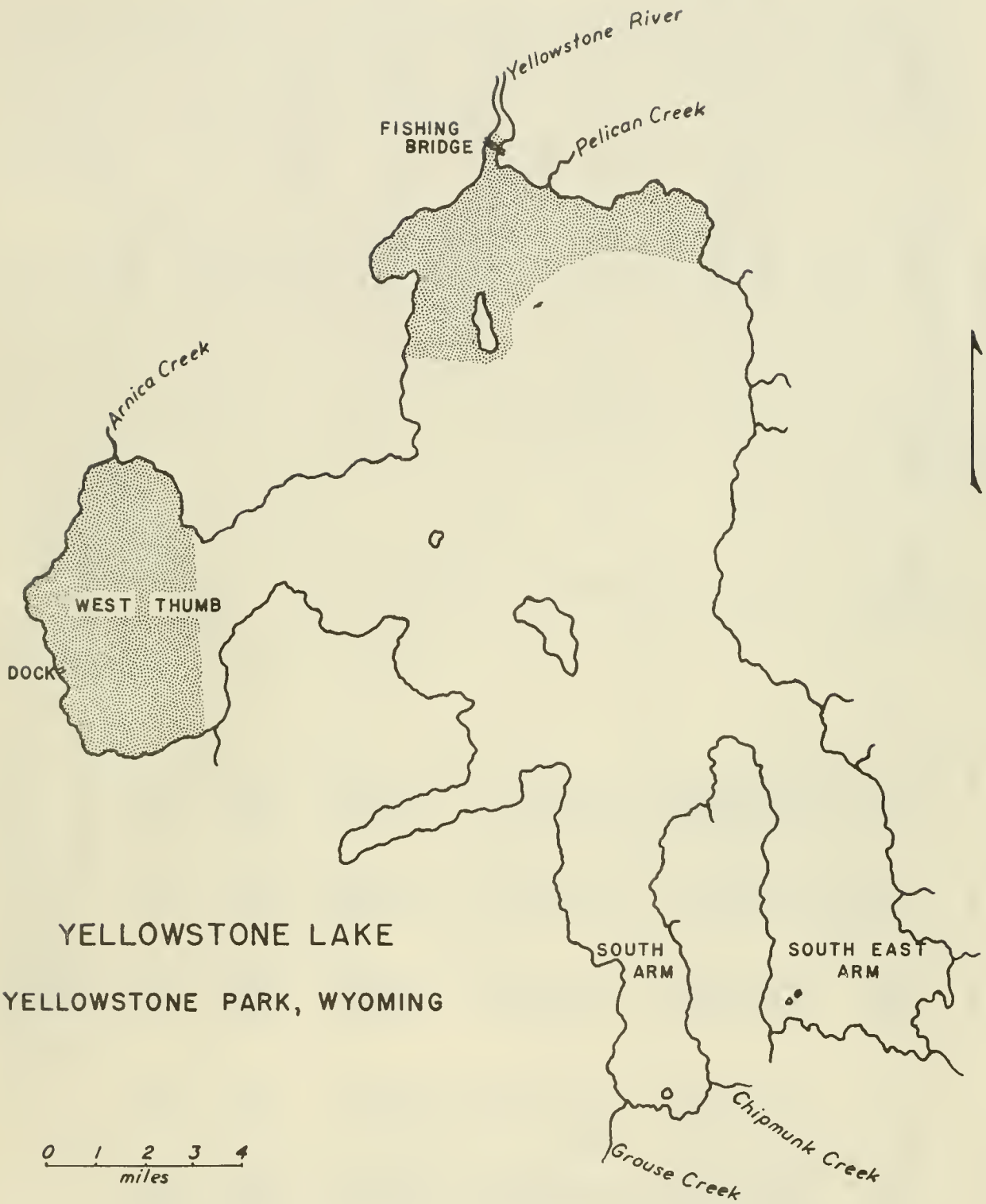

Figure 1--Map of Yellowstone Lake and principal tributaries. Shaded portions denote areas of heaviest fishing pressure.

Table 3.-Mean total lengths of Yellowstone Lake spawning trout, 1943-1952

Stream	Year	Numbers of fish	Sampling distribution	Mean total length (millimeters)	Standard deviation	Comparison between years, significance and "t" values				
						1946	1949	1950	1951	1952
Pelican Creek	1943	604	poor	357.7	26.02	x	x	x	x	x
	1944	1,930	poor	366.1	29.17	x	x	x	x	x
	1945	9,355	good	364.9	27.87	-	x	n.s. t = 0.842	n.s. t = 1.305	* * t = 18.872
	1949	509	poor	344.7	26.76	x	x	x	x	x
	1950	1,870	good	364.3	29.38	-	x	-	n.s. t = 1.184	* * t = 6.239
	1951	1,203	good	363.1	24.77	-	x	-	-	* * t = 5.387
	1952	744	good	355.9	33.05	-	x	-	-	-
Chipmunk Creek	1945	1,537	poor	401.1	32.55	x	x	x	x	x
	1946	6,322	good	362.6	28.17	-	x	* * t = 18.96	* * t = 21.873	x
	1949	395	poor	375.3	31.32	x	x	x	x	x
	1950	1,483	good	378.6	33.22	-	x	-	* * t = 5.098	x
	1951	814	good	385.7	29.98	-	x	-	-	x
	1952	258	poor	373.2	27.12	x	x	x	x	x
Grouse Creek	1944	1,462	poor	361.9	23.15	x	x	x	x	x
	1945	336	poor	358.2	32.15	x	x	x	x	x
	1946	6,102	good	365.1	25.99	-	-	-	* * t = 16.58	* * t = 6.766
	1951	1,197	good	378.9	27.80	-	-	-	-	* * t = 2.578
	1952	343	good	374.7	16.61	-	-	-	-	-
Arnica Creek	1950	953	good	367.6	30.26	-	-	-	* * t = 4.490	* * t = 9.752
	1951	1,252	good	362.8	28.59	-	-	-	-	* * t = 7.365
	1952	956	good	353.5	28.86	-	-	-	-	-
Yellowstone River	1951	276	poor	357.3	26.77	-	-	-	-	x
	1952	382	good	367.7	27.12	-	-	-	-	-

x = No comparison because of poor sampling distribution
n.s. = not significant
* = significant, .05 level
* * = highly significant, .01 level or better

meters (15.2 inches). Table 3 shows that these increases were statistically significant. Grouse Creek, which, like Chipmunk Creek, is tributary to the South Arm, also featured an increase in mean total length of its spawners. Mean total length in 1946 was 365.1 millimeters (14.4 inches), in 1951 it was 378.9 millimeters (14.9 inches), and in 1952 it was 374.7 millimeters (14.8 inches). The increases from 1946 to 1951 and from 1946 to 1952 were significant, and the decrease from 1951 to 1952 was also significant.

This situation, involving decreases in fish length in northern streams and increases and decreases in fish length in southern streams, requires explanation. The most obvious difference between the lake environments of the two groups is in exposure to fishing pressure. Fishing pressure along the northern shore of Yellowstone Lake is several times as intense as that occurring in the south arm. Even though tagging results show that Chipmunk and Grouse Creek fish frequent West Thumb at times, and that Pelican Creek fish often inhabit areas south of the mouth of Pelican Creek, it is evident that fish associated with the northern streams are subjected to heavier fishing intensity than fish in the south. In 1950, it was estimated that 94,271 anglers fished on Yellowstone Lake, (Moore, Cope, and Beckwith, 1952). The figure for 1951 was 163,383, and for 1952, 187,045. It is probable that 95% of the angler effort was expended on the north end of the lake. The fishing pressure in the northern group is suspected to have been so intense as to have caused the observed decline in fish length in Pelican and Arnica Creeks. No reason is offered here for the increases in total length observed on Chipmunk and Grouse Creeks. It seems likely that natural fluctuations could account for these changes.

Comparisons in fish length have been made between streams for the year 1952, and summaries of results are presented in Table 4. Grouse Creek had the longest fish of any stream in which well-distributed samples were taken from the spawning run. Grouse Creek fish had a mean total length of 374.7 millimeters (14.8 inches), while the smaller Yellowstone River spawners measured at the Cascades, five miles downstream from Fishing Bridge, averaged 367.7 millimeters (14.5 inches). Pelican Creek fish averaged 355.9 millimeters (14.0 inches), and Arnica Creek fish averaged 353.3 millimeters (13.9 inches). All comparisons showed significant differences except that between Pelican Creek and Arnica Creek. Here again, the smallest fish occurred in those areas subjected to the heavy fishing pressure, suggesting a casual relationship.

THE FISHERY

Total length measurements were recorded from the Yellowstone Lake fishery in 1950, 1951, and 1952 according to a plan that featured collection of data during the entire angling seasons. The plan not only assured good sampling distribution from the standpoint of time, but permitted certain geographical subdivisions of the drainage to be considered separately.

Table 4.-Comparisons between mean total lengths of fish from 1952 spawning migrations

Stream	Numbers of fish	Mean total lengths	Standard deviation	Significance of differences between total lengths			
				Grouse Creek	Yellowstone River	Pelican Creek	Arnica Creek
Grouse Creek	343	374.7	16.61	-	** t=3.931	** t =9.787	** t =12.617
Yellow-stone River	382	367.7	27.12	-	-	** t =6.144	** t = 8.287
Pelican Creek	744	355.9	33.05	-	-	-	n.s.t = 1.578
Arnica Creek	956	353.5	28.86	-	-	-	-

n.s. = not significant

* = significant, .05 level

* * = highly significant, .01 level or better

Table 5 shows results of comparisons between years in each major area. The designation, "Fishing Bridge Fishery Area" refers to fish brought into Fishing Bridge Dock, Lake Dock, or landed on the shoreline within a few miles of these docks. Parts of Yellowstone Lake contributing to this fishery include those in the upper shaded area on Figure 1. "West Thumb Fishery Area" refers to fish brought into West Thumb Dock or landed on the western shore of West Thumb. The lower shaded area on Figure 1 shows the waters from which these fish were taken. "Combined Fishery" pertains to fish taken from Fishing Bridge Fishery Area, West Thumb Fishery Area, and from other lake areas, such as South Arm, Southeast Arm, Flat Mountain Arm, the Frank Island area and the Delusion Creek area. "River Fishery " applies to fish caught in Yellowstone River between Fishing Bridge and Canyon (not shown on Figure 1).

The results shown in Table 5 indicate that decreases in fish size have taken place. In the Fishing Bridge Fishery Area, significant decreases were measured from 1950 to 1951 and from 1951 to 1952. The mean total length of these trout in 1952 was down to 338.1 millimeters (13.3 inches). The West Thumb Fishery Area showed similar declines, although the reduction in size from 1950 to 1951 was not statistically significant. The mean total length in 1952 was 323.6 millimeters (12.7 inches). In the Combined Fishery significant declines in size were measured between 1950 and 1952 catches and between 1951 and 1952 catches. Mean total length for this unit in 1952 was 336.5 millimeters (13.3 inches).

The River Fishery was sampled only in 1952, so no other year's measurements are available for comparison with the 1952 figure of 330.6 millimeters (13.0 inches).

Table 6 summarizes comparisons between units of the fishery in 1952. The Fishing Bridge Fishery Area and the Combined Fishery had fish of the greatest mean total lengths, but they were not significantly greater than the lengths of Yellowstone River fish. West Thumb Fishery Area fish were significantly shorter than those of the Fishing Bridge Fishery Area and the Combined Fishery, but were not shorter than the river fish.

DISCUSSION OF CHANGES

It appears that the most significant changes in sizes of fish have taken place in the northern part of Yellowstone Lake. The data presented above show that the spawning runs in Pelican Creek and Arnica Creek had smaller fish each year from 1950 to 1952, while those of Chipmunk Creek and Grouse Creek have actually had increases in fish sizes since 1950, along with decreases. This suggests that perhaps normal fluctuations in fish length have been occurring in the southern streams, while a downward trend has been taking place since 1950 in the northern streams.

Table 5.-Mean total lengths, Yellowstone Lake Fishery, 1950-1952

Unit of the Fishery	Year	Numbers of fish	Sampling distribution	Mean total length (millimeters)	Standard deviation	Comparison between years, significance and "t" values	
						1951	1952
Fishing Bridge Fishery Area	1950	884	good	358.9	35.10	* * t = 4.358	* * t = 10.43
	1951	524	good	349.6	41.25	-	* * t = 4.868
	1952	522	good	338.1	38.60	-	-
West Thumb Fishery Area	1950	771	good	338.2	36.34	n.s.t = 0.1967	* * t = 6.474
	1951	547	good	337.8	36.42	-	* * t = 5.7778
	1952	354	good	323.6	35.51	-	-
Lake "Combined Fishery"	1950	1,931	good	345.09	28.23	n.s.t = 1.5380	* * t = 6.0810
	1951	1,063	good	343.2	39.28	-	* * t = 4.0863
	1952	1,071	good	336.5	39.84	-	-
River Fishery	1952	107	good	330.6	47.92	-	-

n.s. = not a significant difference

* = significant, .05 level

* * = highly significant, .01 level or better

Table 6.--Comparisons between mean total lengths of fish from units of the 1952 fishery

Unit of the Fishery	Numbers of fish	Mean total lengths	Standard deviation	Significance of differences between mean total lengths			
				Fishing Bridge	Combined Fishery	Yellowstone River	West Thumb
Fishing Bridge	522	338.1	38.60	-	n.s. t = 0.7421	n.s. t = 1.6877	** t = 5.6333
Combined Fishery	1,071	336.5	39.84	-	-	n.s. t = 1.4318	** t = 5.4202
Yellow-stone River	107	330.6	47.92	-	-	-	n.s.t = 1.6370
West Thumb	354	323.6	35.51	-	-	-	-

n.s. = not significant

* = significant, .05 level

* * = highly significant, .01 level or better

Chipmunk and Grouse Creeks have supported egg-taking activities for several years, but their fish are subjected to only moderate fishing pressure in the South Arm. It is known from tagging operations that many Chipmunk Creek adults move into West Thumb after spawning in Chipmunk Creek, but tagging also suggests that most post-spawners from this stream remain in the South Arm.

Pelican Creek has for many years provided spawn for culture, and has contributed fish to the center of the area of greatest fishing pressure on Yellowstone Lake. Declines have been measured in numbers and sizes of spawners on Pelican Creek in the past five years.

Arnica Creek falls into another category. No egg-taking has occurred on Arnica Creek for many years, but fishing in the West Thumb area, to which Arnica Creek contributes a large share of its fish, has become very intense (see Moore, Cope, and Beckwith, 1952).

It might appear, then, that Chipmunk and Grouse Creeks, with moderate egg-taking and low fishing pressure, have not yet been seriously affected with respect to decrease in sizes and numbers of spawners. Pelican Creek, with heavy egg-taking and heavy fishing pressure, has suffered significant declines in size of fish and numbers of spawners. Arnica Creek, with no egg-taking, but with heavy fishing pressure, has undergone a decrease in spawner size.

Fish in the Fishing Bridge Fishery Area have decreased in size. This is the most heavily fished part of Yellowstone Lake and contributes more fish to the creel than any other part of the lake. The area receives many, if not most, of its fish from northern streams, such as Pelican Creek, which are undergoing decreases in fish size. In the West Thumb Fishery, where angling pressure is second in intensity, a decrease in size has been measured. This area also receives fish from streams, such as Arnica Creek, whose spawners are decreasing in size. The combined lake fishery, being a mixture of fish from population units that show decreases in size, as well as from other areas, showed a decrease from 1951 to 1952 because of the large proportion of northern-caught fish in the catch.

The fishery appears to have suffered a steeper and more definite decline in fish length than have the spawning runs. The probable reason for this is that the fishery has penetrated deep into the younger age groups (two-and three-year-olds), a condition which is immediately manifested in fishery length measurements. The spawners measured in streams have been made up of disproportionately large numbers of younger age groups, but not to the extent seen in the fishery. Practically no two-year-olds enter streams for spawning, and those few that do ascend streams probably do not contribute to the spawning. With the usual paucity of two-year-olds, spawners in streams do not have the opportunity for rapid declines in mean total length that is afforded the fishery.

SUMMARY

Length measurements of Yellowstone black-spotted trout (Salmo clarki lewisi) have been recorded for spawners in various streams tributary to Yellowstone Lake and in the lake fishery by U. S. Fish and Wildlife Service personnel since 1936. Measurements were taken at frequent intervals from 1950 to 1952, and resulted in several series of data suitable for statistical comparisons.

Measurements made early in the program were in terms of standard length, but most of the measurements in the study were made on total length. Fork length measurements were used in other phases of the program. Measurements were taken to establish conversion factors, and in the present paper all lengths are expressed in terms of total length. Conversion factors and a table of conversions are presented. A sexual dimorphism is seen in the conversion factors.

Comparisons between mean total lengths of various years have been made for Pelican Creek, Chipmunk Creek, Grouse Creek, and Arnica Creek. Significant decreases in length have been measured in Pelican Creek and Grouse Creek from 1951 to 1952 and in Arnica Creek from 1950 to 1951 and from 1951 to 1952. Chipmunk Creek fish have shown upward and downward trends in mean total length in the past few years. Streams tributary to the north end of Yellowstone Lake appear to be affected to a greater extent than those entering the south end of the lake.

Comparisons of mean total lengths of fish from streams in 1952 show that of the streams in which good samples were secured, Grouse Creek fish averaged the greatest length (374.7 millimeters,14.8 inches), which was significantly greater than those of all other streams. Yellowstone River spawners averaged 367.7 millimeters (14.5 inches), also significantly different from all other streams. Differences between Pelican Creek fish, at 355.9 millimeters (14.0 inches) and Arnica Creek fish, averaging 353.3 millimeters (13.9 inches),were not significant.

Comparisons of mean total lengths in major fishery areas of Yellowstone Lake indicate that fish brought into Fishing Bridge area have decreased in length each year from 1950 to 1952. Fish caught in the West Thumb area decreased significantly from 1951 to 1952, and fish from the combined fishery (all areas of the lake considered together) decreased in mean total length from 1951 to 1952.

Comparisons between areas in the 1952 season show fish from the Fishing Bridge area to be slightly larger (338.1 millimeters, 13.3 inches) than fish from other areas, but significantly so only in relation to fish from the West Thumb area, at 323.6 millimeters (12.7 inches). Fish from the combined fishery averaged 336.5 millimeters (13.3 inches) in total length, and those from Yellowstone River 330.6 millimeters (13.0 inches).

It is suggested that heavy angling pressure, in combination with egg-taking activities on Pelican Creek, has been a factor in the decrease in length of fish in the northern end of Yellowstone Lake.

ACKNOWLEDGEMENT

Many persons have contributed to the compilation of data upon which this study is based. Fish culturists assigned to the Branch of Game-fish and Hatcheries have played a large part in the program by measuring fish. Mr. William A. Dunn, Superintendent, U.S. Fishery Station, Yellowstone Park, cooperated in this effort by arranging for trout measurements by hatchery personnel as part of the program sponsored by the Branch of Fishery Biology. The names of all contributing fish culturists and fishery biologists are too numerous to mention here, but certain individuals should be given credit for notable effort in the measurement program. These persons are Philip Cuccia, Stacy Gebhards, Thomas Kruse, Kenneth Liscom, Harvey Moore, Albert Regenthal, James Welsh, Bernt Westre, and Dr. Stillman Wright. Assistance in statistical treatment was rendered by Albert Regenthal.

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